Before the
Federal Communications Commission
Washington, DC 20554

In the Matter of Service Rules and Procedures to Govern the Use of Aeronautical Mobile Satellite Service Earth Stations in Frequency Bands Allocated to the Fixed Satellite Service	IB Docket No. 05-20

COMMENTS OF ARINC INCORPORATED

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SUMMARY

ARINC Incorporated ("ARINC"), the communications company of the air transport industry, was recently licensed by the Commission for its SKYLink[SM] Ku-band Aeronautical Mobile Satellite Service ("AMSS") system. SKYLink is the world's first broadband communication service for business aircraft, providing passengers a fully connected "office in the sky." ARINC therefore has considerable experience in the AMSS context, and offers the following comments with that valuable perspective.

The Commission should adopt its *aggregate* off-axis e.i.r.p. envelope proposal. The aggregate envelope adequately protects the FSS from harmful interference in the two-degree spacing environment, and its adoption would be consistent with Recommendation ITU-R M.1643. The issue of feasibility confirms that the aggregate mask is the superior approach. The aggregate mask allows operators more flexibility in assigning power limits for simultaneous co-frequency transmissions, while the individualized approach would not simplify significantly the enforcement and control of e.i.r.p. limits. Additionally, AMSS systems should have the flexibility to coordinate transmissions in excess of the mask, given that no interference issues are raised if adjacent FSS operators agree to higher emissions levels.

There is no basis for the Commission's 0.2 degree pointing accuracy proposal, and it should be rejected. It is inconsistent with WRC-03 and unnecessary in light of the Commission's other proposal to specify an off-axis e.i.r.p. envelope. If off-axis emissions do not violate the mask, there is no risk of harmful interference, regardless of the pointing accuracy of any AES antenna. Moreover, the proposed 0.2 degree rule is not useful. Any mispointing of an AES terminal by 0.2 degrees is likely to have little or no effect on any other satellite, particularly where very small aperture antennas such as those used by the SKYLink system are involved.

Each of the Commission's AES tracking proposals also should be rejected. Requiring general disclosure of these tracking data is not necessary to remedy interference as long as the system licensee has the data and is responsible for the elimination of interference, and a requirement that tracking data be available to third parties would threaten the viability of AMSS service in the nascent business jet market. The Commission should therefore proceed cautiously in this area, and, to the extent it adopts a tracking information rule, it should, at the most, require AMSS operators to share data only upon an occurrence of harmful interference and without any information that might identify the particular aircraft and/or its owner or passengers.

The Commission's proposed licensing structure – which separates out U.S. registered aircraft operating in U.S. airspace, foreign aircraft operating in U.S. airspace, and U.S. aircraft operating in foreign airspace – is not necessary. The Commission should therefore reject its proposal and instead use the Convention on International Civil Aviation's (the "Chicago Convention") existing and well-understood framework to accomplish its goals. All that is needed is for the Commission to codify the application of the Chicago Convention to AMSS operations by adding the AMSS frequencies to Part 87 of the Rules. This would achieve the regulation of AESs in a streamlined manner, while avoiding the international law and comity problems the current proposal raises, but still preserve the FCC's jurisdiction to regulate radio operations over U.S. airspace.

Finally, the Commission should (1) extend ALSAT authority to Ku-band AMSS operators, (2) allow the use of contention protocols permitting statistically-infrequent simultaneous co-frequency transmissions that briefly exceed the mask, (3) permit AMSS operations in the extended Ku-band, and (4) adopt or reject its additional proposals as further explained herein.

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COMMENTS OF ARINC INCORPORATED

ARINC Incorporated ("ARINC") hereby submits its comments in response to the Commission's February 9, 2005, *Notice of Proposed Rulemaking* in the above-captioned proceeding to establish rules for Aeronautical Mobile Satellite Service ("AMSS") systems operating in the Ku band.[1]

ARINC, the communications company of the air transport industry, was recently licensed by the Commission for its SKYLink[SM] Ku-band AMSS system.[2] SKYLink is the world's first broadband communication service for business aircraft. It provides aircraft passengers a fully connected "office in the sky," delivering fast connections to the Internet, virtual private networks, and corporate Intranets. It features uplink (ground-to-aircraft) speeds of between 512

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1 *Service Rules and Procedures to Govern the Use of the Aeronautical Mobile Satellite Service Earth Stations in Frequency Bands Allocated to the Fixed Satellite Service*, Notice of Proposed Rulemaking, 20 FCC Rcd 2906 (2005) (the "*NPRM*" or "*Notice*").

2 *See ARINC Incorporated, Application for Blanket Authority for Operation of Up to One Thousand Technically Identical Ku-Band Transmit/Receive Airborne Mobile Stations Aboard Aircraft Operating in the United States and Adjacent Waters*, Order and Authorization, 20 FCC Rcd 7553 (2005) (the "*SKYLink Order*").

kbps and 3 Mbps, and downlink (aircraft-to-ground) speeds of up to 128 kbps. Today, SKYLink brings "consumers the benefits of broadband services while traveling by air."[3]

Thus, ARINC's SKYLink rollout is fully in accord with, and indeed advances, "the Commission's goals and objectives for market-driven deployment of broadband technologies and efficient spectrum usage."[4] With the Commission's grant of the SKYLink license on April 6, 2005, ARINC commenced commercial operations of the SKYLink system. Before that, the SKYLink system had been in continuous operation under an experimental license since June 2003. ARINC therefore has considerable experience in the AMSS context, and offers the comments below with that valuable perspective in mind.

I. THE COMMISSION SHOULD ADOPT AGGREGATE EIRP DENSITY LIMITS AND ABSTAIN FROM IMPOSING MULTIPLE OPERATING RESTRICTIONS THAT ACHIEVE THE SAME OBJECTIVE.

A. The Commission Should Adopt the Aggregate Envelope Approach and Reject Its Alternative Proposal of Applying the Off-Axis Limits to Individual AESs.

In the *Notice*, the Commission drew aggregate off-axis e.i.r.p. density limits from the VSAT power and antenna gain requirements in Rules 25.134(a)(1) and 25.209(a)(1), respectively,[5] and sought comment on the aggregate mask approach and its feasibility in

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[3] *NPRM* ¶ 2. SKYLink's unique design allows it to be installed on business aircraft such as those manufactured by Gulfstream. Gulfstream offers SKYLink as original equipment on G350, G450, G500, and G550 business jets, and as retrofit installations on all current production Gulfstream large cabin aircraft. The compact SKYLink avionics package from ViaSat, Inc., weighs less than 40 lbs., including the transceiver, antenna, and antenna control unit. The tail-mounted antenna fits under a low-profile radome for low air resistance and maximum fuel economy.

[4] *Id.* ¶ 2.

[5] *See id.* ¶ 35.

practice.[6] The Commission should adopt the aggregate envelope approach, and should reject its alternative proposal of applying the off-axis limits to individual AES terminals.[7]

The aggregate off-axis envelope adequately protects the FSS from harmful interference in the Commission's two-degree spacing environment. The aggregate mask defines the maximum permissible power from the AMSS system at every point in the geostationary arc East or West of the AMSS system's target satellite,[8] and thereby protects adjacent FSS operators. This is confirmed by real world experience in the VSAT context. Compliance with the e.i.r.p. density constraints of routinely authorized VSAT networks – as set forth in Rules 25.134(a)(1) and 25.209(a)(1) – has proven in practice to protect adjacent FSS networks from harmful interference. Like VSATs, the mask alone – even without specifying pointing accuracy – is sufficient in the AMSS context.

Moreover, adoption of the aggregate mask is consistent with Recommendation ITU-R M.1643, as that recommendation adopts an aggregate approach. ITU-R M.1643 states that "AMSS networks should be . . . operated in such a manner that the *aggregate* off-axis e.i.r.p. levels produced by all co-frequency AES within AMSS networks are no greater than the interference levels that have been published and coordinated for the specific and/or typical earth station(s) pertaining to FSS networks where FSS transponders are used."[9] Accordingly, the Commission's alternative approach of applying the mask to individual AES terminals would squarely conflict with the approach adopted at WRC-03. To further the Commission's goal of

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6 *Id.* ¶ 37.

7 *See id.* ¶ 36 (seeking comment "on adjusting the AES off-axis EIRP envelope in Boeing's proposal to apply to individual AES terminals").

8 Technical Appendix at A-1 (attached hereto as Exhibit A).

9 ITU-R M.1643, Annex 1, Part A, § 1 (emphasis added).

"authorizing and licensing AMSS stations [in a manner that is] consistent with the WRC-03 outcome,"[10] the Commission should adopt the aggregate mask and reject the individualized approach.

The issue of feasibility confirms that the aggregate mask is the superior approach. As the Commission recognized in the *Notice*, "adopting an aggregate off-axis EIRP density limit will give more flexibility to Network Control and Monitoring Centers (NCMCs) in assigning power limits to AES for simultaneous co-frequency transmissions, while satisfying the aggregate value."[11] This "permit[s] AES terminals to have different off-axis e.i.r.p. density values depending on each AES characteristics."[12] The fact that "AES terminals are moving rapidly and a network's topology . . . change[s] continuously" is no good reason to cut back on the flexibility offered by the aggregate mask.[13] Contrary to the Commission's query, "enforcement and control of off-axis EIRP density limits on individual AES terminals" would *not* be significantly "simpler for NCMCs than controlling an aggregate value."[14] The sophisticated computer algorithms that are available to and employed by AMSS operators' NCMCs are perfectly capable of aggregating the power levels of AESs across an entire AMSS network, thereby ensuring compliance with the aggregate mask and protection against harmful interference, *without* sacrificing the flexibility that is paramount in an "emerging marketplace" like AMSS.[15]

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10 *NPRM* ¶ 3.

11 *Id.* ¶ 36.

12 *Id.*

13 *Id.*

14 *Id.*

15 *Id.* ¶ 2. Indeed, the SKYLink system controls each AES individually so that its e.i.r.p. is the minimum amount needed to close the link to the satellite, while at the same time monitoring the aggregate spectral density to ensure compliance with the aggregate envelope and the

Similarly, the Commission also should not adopt its proposal to lower the e.i.r.p. density limits in the context of multiple co-frequency transmissions.[16] That proposal is unnecessarily restrictive, as it would rapidly degrade AMSS service at the lower G/T contours of the serving satellite without offering any additional protection against harmful interference. To the contrary, the Commission should align its AMSS rules with those currently proposed in the Part 25 streamlining proceeding to allow statistically-infrequent simultaneous co-frequency transmissions that briefly elevate aggregate earth-station off-axis e.i.r.p. density above the emission envelope.[17]

Nor is there any rational basis for specifying antenna performance requirements when dealing with uplink transmissions.[18] Boeing is correct that the primary purpose of specifying gain characteristics of FSS earth station antennas is to define the protection they receive as a primary service on *downlink* transmissions.[19] It necessarily follows, then, that it would be illogical to specify any antenna performance requirement that is purportedly related to interference concerns for *uplink* transmissions. It also is unnecessary, because the off-axis aggregate mask, by definition, accounts for any variations in antenna performance: If off-axis emissions do not violate the mask, there is no risk of harmful interference, regardless of the

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protection of adjacent satellite operators. As the aggregate limit is approached, SKYLink prohibits additional simultaneous AES transmissions to maintain compliance with the aggregate mask.

16 *Id.* ¶ 36 ("If an AMSS operator chooses to implement a modulation technique, such as CDMA, that can operate with multiple co-frequency transmissions from different AES terminals being simultaneously received at the same satellite, we propose introducing equal off-axis EIRP density limits on each individual AES. That is, if "N" AES transmitters were implemented, each operating on the same channel, transmitting to the same satellite, at the same time, the EIRP density limit on each individual transmitter would be reduced by a factor of 10*log(N), in dB.").

17 *See infra* Part V.

18 *See NPRM* ¶ 39.

19 *Id.*

particular antenna gain of any AES.[20] Accordingly, the Commission should reject any antenna gain requirements that relate to uplink interference concerns.

With regard to minor variances in the aggregate mask, however, the Commission should adopt its proposal.[21] The same industry experience that has shown the aggregate mask to fully protect adjacent satellite operators also has proven that minor variances should be allowed. Indeed, the Commission's proposal mirrors the allowance in Rule 25.209(a)(1) for minor variances in excess of the mask, which has been shown in the VSAT context to provide adequate protection against harmful interference to adjacent satellite networks.[22] The proposal also would mirror the rule adopted in the ESV context,[23] and on this issue, there is no rational basis for distinguishing between ESV and AMSS operations. Thus, the Commission should adopt its proposal allowing minor variances in the e.i.r.p. envelope to be consistent with the Commission's two-degree spacing rules.

Finally, ARINC supports Boeing's proposed rule that allows AMSS systems to have the flexibility to coordinate AES transmissions in excess of the off-axis e.i.r.p. envelope.[24] It is appropriate, moreover, to implement this rule, as Boeing suggests, by allowing AMSS operators to exceed the mask upon "'obtaining a certification from their satellite providers that the

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20 *Cf.* Technical Appendix at A-1-2.

21 *NPRM* ¶ 38 ("For Θ greater than 7.0 degrees, we propose that the envelope may be exceeded by no more than 10% of the sidelobes, provided no individual sidelobe exceeds the e.i.r.p density envelope given above by more than 3 dB.").

22 *Compare supra* note 21, *with* 47 C.F.R. § 25.209(a)(1) ("For Theta greater than 7.0 degrees, the envelope may be exceeded by no more than 10% of the sidelobes, provided no individual sidelobe exceeds the gain envelope [in Rule 25.209(a)(1)] by more than 3 dB.").

23 *Procedures to Govern the Use of Satellite Earth Stations on Board Vessels in the 5925-6425 MHz/3700-4200 Bands and 14.0-14.5 GHz/11.7-12.2GHz Bands*, Report and Order, 20 FCC Rcd 674, ¶ 100 (2005) (the "*ESV Order*"); 47 C.F.R. § 25.222(a)(3).

24 *NPRM* ¶ 40.

aggregate off-axis e.i.r.p. density levels produced by all co-frequency AES terminals communicating with the relevant satellite will be no greater than the interference levels that have been accepted by adjacent satellite systems through the operator-to-operator coordination process.'"[25] These rules promote the Commission's goals of "maximizing the efficient use of Ku-band spectrum,"[26] and of "market-driven deployment of broadband technologies,"[27] while still "protecting existing services from harmful interference."[28] Indeed, if adjacent FSS operators agree to allow e.i.r.p. emissions in excess of the mask, there are no interference concerns for the Commission to address and thus no basis for the Commission to frustrate these voluntary transactions and the efficient functioning of the market. To do so would undercut the Commission's goals, as efficient spectrum use and market-based transactions would be curbed, without any offsetting benefits.

B. The Commission Should Not Adopt Any Antenna Pointing Accuracy Requirements in the AMSS Context.

The Commission has proposed that "an AMSS applicant . . . provide information demonstrating that it has accounted for" "[m]ispointing of AES antennas," "[v]ariations in the antenna pattern of AES," and "[v]ariations in the transmit e.i.r.p. density from AES" "in the design, coordination and operation of an AES."[29] In doing so, the Commission has relied heavily on Recommendation ITU-R M.1643, proposing requirements that are virtually identical to

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25 *Id.* ¶ 40 (quoting *Amendment of Parts 2 and 25 of the Commission's Rules to Allocate Spectrum in the 14-14.5 GHz Band to the Aeronautical Mobile-Satellite Service ("AMSS") and to Adopt Licensing and Service Rules for AMSS Operations in the Ku-Band*, The Boeing Company, Petition for Rulemaking, at 16 (July 21, 2003) ("Boeing Petition")).

26 *Id.* ¶ 4.

27 *Id.* ¶ 2.

28 *Id.*

29 *Id.* ¶ 41.

Annex 1, Part A, Section 2 of that Recommendation, with one exception: The Commission has added a "pointing accuracy" requirement to its proposal, while no such specification exists in ITU-R M.1643. As explained below, the Commission should not adopt such a pointing accuracy rule in the AMSS context.

Generally speaking, adopting the factors from Annex 1, Part A, Section 2 of ITU-R M.1643 in future AMSS rules is prudent. As the Commission recognized in the *Notice*, "[t]hese factors could vary the aggregate off-axis e.i.r.p. density levels generated by the AES."[30] They therefore should be taken into account, to the extent applicable, in designing and operating an AMSS system. Indeed, ARINC demonstrated that it considered all of those factors in receiving the license for its SKYLink system. In particular, ARINC performed two Monte Carlo simulations that accounted for variations in AES antenna patterns, power control and transponder power fluctuations, airframe flexure, internal navigation system inaccuracy, and mispointing of AES antennas.[31] Thus, the *SKYLink Order* "conclude[d] that ARINC has adequately accounted for pointing error,"[32] and the two other relevant factors in ITU-R M.1643, Annex 1, Part A, Section 2.[33]

But there is no basis for the Commission's *additional* proposal in the *Notice* "that the AES operator should maintain pointing accuracy within 0.2 degrees for all antennas within its licensed network."[34] *First*, contrary to the Commission's claim, such a pointing accuracy

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30 *Id.*

31 *See, e.g.*, *SKYLink Order* ¶ 25.

32 *Id.* ¶ 41.

33 *Id.* ¶ 25 (noting ARINC's accounting for variation in AES antenna patterns); *id.* ¶¶ 42-46 (discussing transponder G/T variation, rain fade, power-control error, and calibration error).

34 *NPRM* ¶ 41(i).

requirement is *not* "consistent with WRC-03."[35] The Commission appears to have conflated the ESV and AMSS outcomes of WRC-03.[36] While it is the case that WRC-03 Resolution 902, which contains ESV technical parameters, suggests a peak "tracking accuracy" for ESV antenna of 0.2 degrees,[37] the AMSS technical guidelines set forth in ITU-R M.1643 do not contain any similar "tracking" or "pointing accuracy" requirement.[38] Thus, the Commission's 0.2 degree pointing accuracy proposal is *inconsistent* with WRC-03, and should be rejected in order to satisfy the Commission's stated goal of adopting "methods for authorizing and licensing AMSS stations that are *consistent* with the WRC-03 outcome."[39]

Second, the 0.2 degree pointing accuracy requirement is unnecessary in light of the Commission's other proposal to specify an off-axis e.i.r.p. envelope. That envelope sets forth the maximum power levels at each point along the geostationary arc.[40] Antenna mispointing as well as antenna sidelobes are fully accounted for in the application of the off-axis e.i.r.p.

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35 *Id.* (stating that "consistent with WRC-03, we are proposing that the AES operator should maintain pointing accuracy within 0.2 degrees for all antennas within its licensed network").

36 *Compare ESV Order* ¶ 103 ("[C]onsistent with WRC-03, we require that Ku-band ESV operators maintain a pointing accuracy of no less than 0.2 degrees for all antennas within their licensed network.), *with NPRM* ¶ 41(i) ("[C]onsistent with WRC-03, we are proposing that the AES operator should maintain pointing accuracy within 0.2 degrees for all antennas within its licensed network").

37 ITU-R Resolution 902 (WRC-03), Annex 2.

38 *See* Recommendation ITU-R M. 1643. The fact that WRC-03 Resolution 902, which applies to ESVs, includes a tracking accuracy specification while ITU-R M.1643, which covers AMSS, does not have such a requirement implicitly recognizes the difference between the two operating environments. Ships can carry larger antennas with more narrow beamwidths than can aircraft, especially relatively small corporate aircraft. The narrower beamwidths possible (but not required) in the ESV environment mean that a small deviation in tracking accuracy will have a greater impact on the radiation toward an adjacent satellite than would be the case of the SKYLink antennas with a half-power beamwidth on the order of five degrees. *See* Technical Appendix at A-3.

39 *NPRM* ¶ 3 (emphasis added).

40 Technical Appendix at A-1.

envelope. Because the off-axis envelope already takes pointing error into account, it is unnecessary and logically inconsistent to impose antenna pointing requirements in addition to the mask.[41]

Indeed, the Commission itself recognized in the ESV context that the off-axis e.i.r.p. limits alone provide ample protection to adjacent satellite systems. In the *ESV Order*, the Commission "decline[d] to adopt [its] proposal, set forth in the *ESV NPRM*, to require a minimum antenna size for Ku-band ESVs,"[42] and thus "eliminate[d] the need to regulate the specific size of the antenna being used."[43] It based its decision on the sound conclusion "that [the Commission] can provide *the same protection* to adjacent satellite operators by adopting off-axis e.i.r.p. limits for ESV operations,"[44] noting that it was "satisfied that the off-axis e.i.r.p. limits in [the *ESV Order*] adequately protect adjacent satellite systems and ensure that ESVs do not cause harmful interference to adjacent FSS satellite operators."[45] The same reasoning applies with equal force here. As matter of logic and engineering, it is unnecessary to specify a pointing accuracy rule when an off-axis e.i.r.p. limit is also specified, because such an emission limit "adequately protect[s] adjacent satellite systems and ensure[s] that [AES]s do not cause harmful interference to adjacent FSS satellite operators."[46]

Third, the proposed 0.2 degree pointing accuracy rule is not useful. Geostationary satellites are spaced two degrees apart. Any mispointing of an AES terminal by 0.2 degrees is

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41 *Id.*

42 *ESV Order* ¶ 103.

43 *Id.* ¶ 104.

44 *Id.* (emphasis added).

45 *Id.* ¶ 103.

46 *Id.*

likely to have little or no effect on any other satellite.[47] This is particularly true for very small aperture antennas such as those used in ARINC's SKYLink system, where required compliance with the off-axis e.i.r.p. mask already results in a significant reduction in the radiated power of the system.[48] Figure 1 in the attached Technical Appendix demonstrates the simulated result of mispointing a Ku-band antenna similar to those ARINC has operated successfully in its SKYLink system for many thousands of hours without causing interference to other systems. As Figure 1 demonstrates, even when the antenna is mispointed by a full four degrees, which is twenty times the 0.2 degree value in the Commission's proposed requirement, it does not encroach on the off-axis e.i.r.p. limit.[49]

Thus, by its terms, the aggregate off-axis e.i.r.p. mask permits a limited amount of energy to be radiated off axis, regardless of the specified pointing error.[50] This simple fact means that any pointing accuracy specification has little, if any, value for protecting adjacent satellites from harmful interference. Put simply, if off-axis emissions do not violate the mask, there is no risk of harmful interference, regardless of the particular pointing accuracy of the AMSS antenna.[51]

Finally, the proposed pointing accuracy rule would have the unintended consequence of limiting technological advancement. The Commission's rules should permit – indeed, should *encourage* – innovation and technological advancement. ARINC's SKYLink system, for example, is based in part on managing and controlling the aggregate off-axis e.i.r.p. of all earth

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47 Technical Appendix at A-1.

48 *Id.*

49 *Id.*

50 *Id.*

51 *Id.* at A-2.

station terminals.[52] Notwithstanding the fact that small aperture antennas used on business aircraft have relatively wide beamwidths, by limiting each terminal to the minimum power needed to close the link, ARINC is able to permit more users to have simultaneous access to the SKYLink system without exceeding the aggregate off-axis e.i.r.p. mask. Another, albeit more extreme, approach would be a mobile terminal that employed an omnidirectional antenna with no main lobe.[53] If such an antenna complied with the off-axis e.i.r.p. mask, it would pose no interference problems for adjacent satellite operators. But a pointing accuracy for such a system would have no meaning. At bottom, any pointing accuracy requirement must be a function of both antenna power and beamwidth, and the single most effective way to deal with these effects is to specify *only* the aggregate off-axis e.i.r.p.[54]

In sum, innovative approaches and technologies can be employed to guard against the potential for harmful interference, and the Commission should incentivize AMSS system operators – by "minimiz[ing] the burdens upon . . . licensees,"[55] and through "more flexible use of the Ku-band,"[56] – to innovate and develop new approaches and technologies to provide service while at the same time complying with the emissions mask and thus protecting against the unlikely harmful interference event. So long as AMSS system operations comply with the off-axis e.i.r.p. limits, adjacent satellite operators will be protected, and the particular methods or technologies used by operators to comply with the envelope need not – indeed, *should not* – be specified. To do so would stifle innovation and new approaches and technologies for providing

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52 *Id.*

53 *Id.*

54 *Id.*

55 *NPRM* ¶ 4.

56 *Id.* ¶ 2.

service. Given the Commission's recognition of the need for "enhanced rights and limited regulation" in the Ku band,[57] as well as its "goals and objectives for market-driven deployment of broadband technologies,"[58] the Commission should not adopt a pointing accuracy requirement in the AMSS context.

II. THE COMMISSION SHOULD PROCEED CAUTIOUSLY IN EVALUATING AES TRACKING PROPOSALS AND, IN ALL EVENTS, SHOULD NOT ADOPT ANY RULES THAT WOULD UNDERMINE THE VIABILITY OF AMSS SERVICE IN THE BUSINESS JET MARKET.

The Commission has proffered several AES tracking proposals,[59] each of which should be rejected as currently written. In the first place, the Commission should *not* obligate AMSS operators to provide aircraft tracking data to the Commission, third parties and/or other government agencies as a matter of course (*i.e.*, in the absence of a harmful interference event).[60] These data are not necessary to remedy interference as long as the system licensee has the data and is responsible for the elimination of interference. Moreover, a requirement that tracking data be widely available – especially if the operator of the aircraft would be identifiable – would threaten the viability of AMSS service in the nascent business jet market. Corporate users and individuals who own, lease, or otherwise fly on business jets are particularly sensitive, as are most persons in a free society, about their location being tracked. These business jets are often owned or used by a single person (or small group of persons), and therefore tracking data could

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57 *ESV Order* ¶ 2.

58 *NPRM* ¶ 2.

59 *Id.* ¶¶ 54-55.

60 *See id.* ¶ 54 ("The Commission would have a record of where AES terminals have operated and, if it receives a complaint of harmful interference, the interference could be eliminated or the AMSS operator could be ruled out as having caused the harmful interference. We seek comment on the anticipated effectiveness and utility of this process and whether a trial period could be implemented to gain experience with the process.").

allow a person's location and travels to be monitored. This would not be acceptable to business jet clientele, even if that tracking data were released on a delayed (*i.e.*, not "real time") basis.

As the Commission correctly recognized in the *Notice*, "'real time' public access to exact aircraft location information may present a security risk for the aircraft."[61] This is true even if the data were not strictly "public," but were otherwise generally available to third parties and/or government agencies, because this type of electronic information is *never* completely secure, even for businesses and government agencies to which security is a foremost concern.[62] Indeed, delayed (*i.e.*, not "real time") data raise the same concerns, as they would divulge travel *patterns* that could be used to determine and/or predict an aircraft's (and thus a person's) location. A further risk is that corporate aircraft location information, even not in real time, poses a real

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61 *Id.* ¶ 54.

62 *See, e.g.*, Cassell Bryan-Low, *Asian Hackers Blamed for Attacks On U.K., U.S. Computer Networks: Bid to Steal Valuable Data Targets Corporate Systems, Government Institutions*, Wall St. J., June 20, 2005, at A13 ("The British government Thursday announced that hackers seeking commercially and economically valuable information were attacking vital U.K. government and corporate computer networks. . . . Hundreds of U.S. institutions have been targeted, [a law-enforcement] official said. . . . Government agencies and suppliers, such as defense contractors, were also targeted, he added. . . . He said some data had been taken, including information related to technology research and development."); David Pringle & Rachel Zimmerman, *LexisNexis Reveals Further Breaches of Database*, Wall St. J., Apr. 13, 2005, at B3 ("LexisNexis said 310,000 Americans, nearly 10 times its original estimate, have had their personal data accessed by unauthorized individuals via its computer systems, raising fresh concerns about the data-collection industry's ability to guard against hackers amid a surge in identity-theft crimes."); Robert Tomsho, *College Alumni Data Are Breached by Hacker*, Wall St. J., Mar. 17, 2005 ("Boston College sent letters to more than 100,000 of its alumni warning them a hacker had breached a university computer system containing personal data including their Social Security numbers."); Evan Perez & Rick Brooks, *ChoicePoint Breach, Stock Sales Are Both Under Federal Scrutiny*, Wall St. J., Mar. 7, 2005, at A2 ("Two federal investigations have been launched into a security breach at ChoicePoint Inc. that allowed an identity-theft ring access to personal data on about 145,000 people."); Ann Carrns, *Bank of America Is Missing Tapes With Card Data*, Wall St. J., Feb. 28, 2005, at B2 ("Bank of America Corp. said it lost computer backup tapes containing personal information such as names and Social Security numbers on about 1.2 million federal-government charge cards."); *see also Without A Trace*, Wall St. J. Online, June 17, 2005 (noting that "[i]n the last few months, several major companies reported that customer data, including credit-card information, was compromised" and listing examples).

threat of industrial espionage or premature divulgence of inside information. For example, the presence of a corporate aircraft of Company A in an out-of-the-way city with the headquarters of Company B could betray nonpublic material information, such as the existence of ongoing merger discussions. Since these types of discussions often take place over many months, if not years in some cases, even delayed tracking information could be used to connect the dots.

The Commission's final rule also should take full account of the privacy rights of business jet owners and travelers. "[E]ven in an area accessible to the public," such as the nation's airports and airspace, the Fourth Amendment establishes a privacy right where an individual "shuts the door behind him," exhibiting an actual, subjective expectation of privacy.[63] Technological advances that might allow location tracking are not permitted to whittle down this fundamental right.[64] In analogous circumstances, Congress has enacted detailed requirements, backed by tough penalties, forbidding telecom service providers from disclosing customer *location* information to third parties without "express prior authorization."[65] Privacy concerns underpin limitations on all federal agencies, curbing the government's authority to disclose personal information[66] and limiting all information collections to those "*necessary* for the proper performance of the functions of the agency."[67] As discussed below, satellite operators have a proven track record in resolving interference issues, rendering FCC collection of AES tracking data manifestly *unnecessary*. At a minimum, because AES tracking data would allow

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63 *See Katz v. United States*, 389 U.S. 347, 351, 352 (1967) (J. Harlan, concurring).

64 *See Kyllo v. United States*, 533 U.S. 27, 40 (2001).

65 47 U.S.C. § 222(f).

66 *See* Privacy Act, 5 U.S.C. § 552a(b).

67 *See* Paperwork Reduction Act, 44 U.S.C. §§ 3506(c)(3)(A); 3508 (emphasis added).

monitoring of business jet passengers' travel, the FCC should determine that such data are exempt from disclosure under the Freedom of Information Act.[68]

It is for all of these reasons that AMSS operators are constrained by contract not to divulge aircraft flight plans or actual tracking data to any party. To use flight track and transmission data for purposes of interference resolution, ARINC would be required to strip that data of all information that might identify the particular aircraft and/or its owner or passengers. Even if tracking data were not made "public," ARINC's contractual strictures would still apply to any release of tracking information to third parties and/or government agencies. Accordingly, the Commission should proceed cautiously in this area, and should not require that tracking data be disclosed to the Commission, third parties, and/or other governmental agencies in the absence of a harmful interference event.[69]

Instead, the Commission would be wise to consider the excellent track record of satellite operators cooperating with each other to locate and eliminate interference, whether harmful or just perceptible. The Ku-band satellite operators already have a close working relationship with one another to tracking down an interferer. AMSS network operators use the services of those same satellite operators for their network distribution and would be constrained by the same rules and protocols extant in that industry. AMSS operators are required to register their AES frequency and modulation data with the satellite operators to gain access to the transponders to which they have been assigned. Thus, to the extent the Commission adopts a tracking

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[68] *See* 5 U.S.C. § 552(b)(4), (b)(6) (FOIA does not require disclosure of confidential trade secret or commercial information or personal information when disclosure constitutes a clearly unwarranted invasion of personal privacy).

[69] *Cf. ESV Order* ¶¶ 112-13 (agreeing "that the risk associated with ubiquitous distribution of . . . tracking information outweighs the benefit is may provide in preventing interference to other operators," and only requiring the provision of tracking information "to assist in resolving any unexpected interference concerns with incumbents").

information rule, it should, at the most, require AMSS operators to share certain tracking data with frequency coordinators, FSS operators, the Commission or NTIA, but only upon an occurrence of harmful interference and *without any information that might identify the particular aircraft and/or its owner or passengers*. And any such information should be shared only pursuant confidentiality agreements already in place or, to the extent those do not already exist, under a standard non-disclosure agreement with built-in liquidated damage penalties for the unauthorized disclosure of such tracking data.

In all events, AMSS operators should not be obligated to disclose data that would identify the particular aircraft and/or its owner or passengers.[70] Such a requirement would threaten the commercial viability of the service in the business jet market. Nor is that information needed by third parties or government agencies to resolve interference concerns. It is sufficient for the AMSS operator simply to provide the location of transmitting AESs in its network (without particular aircraft tail number, owner, passenger, or other identifying information) and the operating frequency information of those AES. If in the unlikely event it is determined that a particular AES has caused harmful interference, the AMSS operator is the party that should be responsible to remedy the problem and, if necessary, shut down transmissions for that AES. That way the AMSS operator is charged with communicating with the particular aircraft owner or operator to resolve the particular interference issue, and each interested party will be functioning within the realm of their expertise and confidentiality arrangements.

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[70] *NPRM* ¶ 55 ("We seek comment whether AMSS operators should be required to make *exact aircraft location* information accessible, in a secure fashion, to individual operators in the Ku-band so that they can identify a potentially interfering AES, or should AMSS operators be required to make this information accessible to a third-party, single point of contact representing commercial or government agencies?" (emphasis added)).

Finally, from its perspective as an aeronautical data communications organization, ARINC believes that it is unreasonable and unnecessary to saddle AMSS operators with the obligation to maintain aircraft tracking data for a full one-year period.[71] With the numbers of commercial aircraft, general aviation aircraft, and military aircraft airborne over the continental U.S. everyday, many of which will be AES equipped in the future, the volume of data to be collected and stored would be prohibitive, as would developing the systems to search that vast pool of data expeditiously for a single interference event. A more realistic and measured approach would be to require data retention for 30 days, unless there are unresolved harmful interference issues.[72] In that case, those AMSS operators with AES operating in the frequency range pertaining to the unresolved interference issue could be mandated to retain pertinent data until the issue is resolved. This approach would incentivize those parties with interference issues, in the unlikely event that any such concerns arise, to bring them to the fore immediately for resolution.

III. THE COMMISSION SHOULD NOT REQUIRE OPERATORS OF FOREIGN-REGISTERED AIRCRAFT TO OBTAIN AN FCC LICENSE IN ORDER TO TRANSMIT WHILE IN FLIGHT OVER THE UNITED STATES.

The Commission proposes a complex new licensing structure for aircraft stations using AMSS, separating out U.S. registered aircraft operating in U.S. airspace, foreign aircraft operating in U.S. airspace, and U.S. aircraft operating in foreign airspace. The new structure is not necessary in that the Convention on International Civil Aviation (the "Chicago

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71 *Id.* ¶ 54 (seeking comment on "whether AMSS operators should maintain aircraft tracking data for a one-year period of time").

72 This period is consistent with ARINC's retention of communications records for scheduled air carriers. *See* 14 C.F.R. § 121.711.

Convention")[73] already addresses this issue in a regimen that has been accepted for almost six decades. Under the Chicago Convention, the aircraft stations should be licensed by the country in which the aircraft is registered, but will still be subject to the regulations of the country overflown.[74] All that is needed is for the Commission to codify the application of the Chicago Convention to AMSS operations by adding the AMSS frequencies to Part 87 of the Rules.

The Commission seems to think that to control potential interference and facilitate the international movement of AESs, "the operator of [an] AES on [a] foreign registered aircraft . . . [must] apply for a license authorizing transmissions while traveling through U.S. airspace."[75] This requirement would be imposed both on non-U.S. registered aircraft using U.S.-operated AMSS systems and non-U.S. registered aircraft using foreign-based and foreign-licensed AMSS systems.[76] The Commission argues that "[b]y its terms, the Chicago Convention does not prohibit the nation over which the foreign registered aircraft is flying from also issuing a license,"[77] and that, after obtaining a license, "[t]he licensee would then be subject to any and all rules [the Commission] may adopt concerning AMSS operations."[78]

The Commission's proposal to license AESs on foreign-registered aircraft is misguided and contravenes international law. The Commission should not require operators of foreign-registered aircraft to obtain an FCC license to transmit while in flight over the United States.

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73 Convention on International Civil Aviation, Dec. 7, 1944, 61 Stat. 1180, TIAS 1591 ("Chicago Convention").

74 Chicago Convention, Articles 29, 30.

75 *NPRM* ¶ 61.

76 *Id.* ¶¶ 61, 65.

77 *Id.* ¶ 61 n.156.

78 *Id.* ¶ 61.

Such licensing would contradict the purpose and duplicate the function of the Chicago Convention, which proscribes multiple licensing of aircraft transmissions. Instead, the Commission should use the Chicago Convention's existing and well-understood framework to accomplish its goals. For U.S. registered aircraft, the Commission need only amend Sections 87.173 and 87.187 to add 14.0-14.5 GHz as part of the aircraft radio license, subject to the rules to be adopted under Part 25. At that point, U.S. registered aircraft could use SKYLink and other Ku-band AMSS anywhere in the world, subject to the regulations of the country in whose airspace the aircraft is operating. By the same token, foreign administrations will license aircraft registered in their countries and those aircraft will be permitted to use Ku-band AMSS in the United States, subject to the Commission's requirements.

Article 30 of the Chicago Convention states that:

> aircraft of each contracting State may, in or over the territory of other contracting States carry radio transmitting apparatus only if a license to install and operate such apparatus has been issued by the appropriate authorities of the State in which the aircraft is registered. The use of the radio transmitting apparatus in the territory of the contracting State whose territory is flown over shall be in accordance with the regulations prescribed by that State.

By its terms, then, the only license *required* for operation of radio equipment over *all* contracting States is the license issued by the aircraft's country of registration. By signing the Chicago Convention, countries essentially agreed to defer licensing of aircraft earth stations to the country of aircraft registry, but retained the ability to create individualized regulations for operation over their airspace.

In addition, Article 33 provides that "licenses issued or rendered valid by the contracting State in which the aircraft is registered, shall be recognized as valid by the other contracting States, provided that the requirements under which such certificates or licenses were issued or

rendered valid are equal to or above the minimum standards which may be established from time to time pursuant to this Convention."

Thus, the Commission's proposal contravenes the purpose of the Chicago Convention. Any attempt by the Commission to license AESs on foreign-registered aircraft would contradict the U.S. government's pledge to defer licensing of radio transmissions on foreign-registered aircraft and would invalidate the recognition of foreign radio licenses that is required by Article 33. In addition, the Commission's proposal duplicates the function of the Chicago Convention. The Chicago Convention was created to avoid unnecessary licensing procedures, but it was also meant to protect contracting states. Thus, the Commission's concern that licensees "be subject to any and all rules" that the FCC creates regarding AMSS is already contemplated by Article 30's requirement that operation of AMSS systems be "in accordance with the regulations" of the overflown state.[79]

Moreover, as a policy matter, the Commission should not impose additional licensing procedures on foreign-registered aircraft. The Preamble of the Chicago Convention states that its purpose is "to avoid friction and to promote that cooperation between nations and peoples upon which the peace of the world depends."[80] In furtherance of this goal, the signatories of the Chicago Convention "agreed on certain principles and arrangements in order that international civil aviation may be developed in a safe and orderly manner and that international air transport services may be established on the basis of equality of opportunity and operated soundly and economically."[81] Requiring a foreign registered aircraft to obtain a U.S. earth station license

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79 Chicago Convention, Article 30.

80 Chicago Convention, Preamble.

81 *Id*.

would contravene the goal of orderly and economical operation of civil aviation by burdening foreign operators with a potentially time consuming and costly licensing procedure, despite the fact that they already have the necessary authorization to operate from their home country. Moreover, if the Commission were to require foreign aircraft to obtain U.S. licenses, foreign regulators would likely respond in kind – thus subjecting U.S. entities to unnecessary and potentially onerous foreign licensing procedures.

A better solution would be to add the AMSS frequencies to Part 87 of the Rules, which would codify the application of the Chicago Convention to AMSS operations, consistent with the Commission's past treatment of AMSS AESs.[82] This proposal achieves the Commission's goals for regulating AESs in a simple, streamlined manner and avoids the issues of international law and comity discussed above, while preserving the FCC's jurisdiction to regulate radio operations over U.S. airspace. In addition, the terms and requirements of the Chicago Convention are well-understood by the contracting states and airlines, and it has effectively served its function for the last 60 years.

IV. THE COMMISSION SHOULD EXTEND ALSAT AUTHORITY TO KU-BAND AMSS OPERATORS.

ARINC strongly supports authorizing Ku-band AMSS operators to operate with any U.S.-licensed satellite and non-U.S satellites on the Permitted List (*i.e.*, ALSAT authority).[83] Boeing is correct to point out that "that no technical reason exists to prohibit Ku-band AMSS from operating pursuant to ALSAT authority because these systems must be compliant with the

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[82] *See Amendment of Part 87 of the Commission's Rules to Establish Technical Standards and Licensing Procedures for Aircraft Earth Stations*, Report and Order, 7 FCC Rcd 5895, 5895 (¶ 3) (1992) (noting that the Commission established technical standards for AMS(R)S and AMSS in Part 87 because AMS(R)S was meant to "provide domestic and international communication capability directly related to the safety and regularity of flight" and AMSS operations could be provided by the same station).

[83] *See NPRM* ¶ 51.

Commission's 2-degree spacing rules, and cannot interfere with adjacent satellite operators."[84] In other words, if the AMSS systems complies with the off-axis e.i.r.p. envelope with regard to one satellite in the Commission's two-degree spacing environment, it complies with regard to all such satellites. There are thus no interference concerns raised by the grant of ALSAT authority here.

Moreover, granting ALSAT authority in the AMSS context is justified by all of the same reasons that the Commission extended such authority to the ESV context. "Affording this flexibility to Ku-band [AMSS] operators helps to ensure the viability of the service by providing them the flexibility to negotiate with multiple satellite service providers,"[85] and "encourages all Ku-band [AMSS] operators to design their systems in a manner that will protect satellite service providers with which they currently interface as well as those with which they may seek to interface in the future."[86] In addition, "[t]he ability to utilize numerous FSS satellite capacity providers also . . . enhance[s] competition and reduce[s] the costs of providing [AMSS] services."[87] And "requiring Ku-band [AMSS] operators to file an application every time they wish to change satellite providers is costly to both the applicant and the Commission."[88]

Accordingly, the Commission should grant ALSAT authority to Ku-band AMSS operators whose systems comply with the off-axis e.i.r.p. envelope. However, if AMSS operators have coordinated with adjacent satellite operators for power levels in excess of the mask, the basis for ALSAT authority evaporates because the adjacent satellite operators at the

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84 *Id.* (citing Boeing Petition at 23-24).

85 *ESV Order* ¶ 105.

86 *Id.*

87 *Id.* ¶ 106.

88 *Id.*

new satellite location would not have agreed to those increased levels. In this regard, ARINC agrees with the Commission's tentative conclusion that ALSAT authority should not apply "to those AMSS applicants whose operations must be coordinated with adjacent satellite operators" because their "AES terminals exceed the proposed off-axis EIRP density requirements."[89]

V. THE COMMISSION SHOULD ADOPT IN THIS PROCEEDING ITS PROPOSAL IN THE VSAT CONTEXT TO ALLOW USE OF CONTENTION PROTOCOLS PERMITTING STATISTICALLY-INFREQUENT SIMULTANEOUS CO-FREQUENCY TRANSMISSIONS THAT BRIEFLY EXCEED THE OFF-AXIS EMISSION ENVELOPE.

In the Part 25 streamlining proceeding, the Commission has concluded that the use of contention protocols increases efficiency,[90] that Section 25.134 must be revised to allow contention protocols, and that new contention protocol rules, among other things, should "allow VSAT operators to exceed the proposed aggregate off-axis EIRP envelope for a small percentage of time."[91] In the *SKYLink Order*, the Commission summarized its current proposal on this issue:

> The Commission concluded more recently that Section 25.134 should be amended to allow use of contention protocols permitting statistically-infrequent simultaneous co-frequency transmissions that briefly elevate aggregate earth-station off-axis e.i.r.p. density above the VSAT emission envelope. Specifically, the Commission proposed to amend Section 25.134 to allow VSAT systems using contention protocols to generate aggregate off-axis e.i.r.p. continuously exceeding the VSAT emission envelope for 100 milliseconds or less by amounts varying inversely with the overall percentage of the time that the envelope is exceeded: 2 dB over the envelope one percent of the time, 4 dB over 0.1% of the time, 6 dB over 0.01% of the time, 8 dB over 0.001% of the time, etc. The

89 *NPRM* ¶ 51.

90 *2000 Biennial Regulatory Review – Streamlining and Other Revisions of Part 25 of the Commission's Rules Governing the Licensing of, and Spectrum Usage by, Satellite Network Earth Stations and Space Stations*, Sixth Report and Order and Third Further Notice of Proposed Rulemaking, 20 FCC Rcd 5593, ¶ 103 (2005) ("*Sixth R&O and Third FNPRM*").

91 *Sixth R&O and Third FNPRM* ¶ 136.

> proposed rule would also apply to VSAT networks using contention access protocols in combination with CDMA.[92]

The Commission should adopt the same proposal here, for the reasons set forth in full in the record in the Part 25 streamlining proceeding. There is no rational basis to allow VSAT contention protocol systems to exceed the mask for statistically infrequent periods of time, but not also provide the same relief in this proceeding.

VI. FREQUENCY ALLOCATION AND TDRSS/RAS ISSUES.

A. AMSS Operations Should Be Permitted in the Extended Ku-band.

ARINC strongly urges the Commission to permit AMSS operations in the 10.95-11.2 and 11.45-11.7 GHz bands (*i.e.*, the "extended" Ku-band).[93] As Boeing noted in its Petition, Ku-band FSS downlinks are permitted in the extended Ku-band outside the United States.[94] Thus, allowing the use of this band will enable AMSS operators to operate globally at the same frequencies. Moreover, the Commission correctly "recognize[d] that AES terminals on U.S.-registered aircraft may need to access foreign satellites while traveling outside of the United States (*e.g.*, over international waters), and therefore may need to downlink in the extended Ku-band in certain circumstances."[95] Allowing AMSS in the extended Ku-band, therefore, would facilitate more efficient and flexible operations both within the U.S. and abroad. Nor is there any reason to anticipate that AMSS receive-only operations within the United States would "interfere

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92 *SKYLink Order* ¶ 22 (footnotes omitted); *see also Sixth R&O and Third FNPRM* ¶¶ 103, 119, 128, 136.

93 *See NPRM* ¶ 18.

94 Boeing Petition at 12.

95 *NPRM* ¶ 18.

with or restrict other authorized operations in the band."[96] Accordingly, the Commission should permit AMSS downlink operation in the extended Ku-band.

B. The Commission Should Allow AMSS Operators and NTIA to Determine the Level of Interference Protection Needed for Current TDRSS and RAS Sites, and Should Permit the Expansion of TDRSS and RAS Sites Only in a Future Rulemaking When the Locations and Requirements of these Sites Are Better Understood.

The Commission has proposed that, as a prerequisite to licensing, AMSS operations be coordinated with the National Telecommunications and Information Administration ("NTIA") to resolve any potential interference with Tracking and Data Relay Satellite System ("TDRSS") stations or Radio Astronomy Service ("RAS") sites.[97] To this end, the Commission suggests that "[o]ne option" is that AMSS operators simply agree not operate in the "'vicinity of'" (*i.e.*, within the line-of-sight of) current TDRSS and RAS sites.[98] While ARINC acknowledges the need to protect currently operating TDRSS and RAS sites from interference through coordination with NTIA, a rigid "vicinity of," or "line of sight," rule would be too restrictive and should not be imposed.

AMSS operators and NTIA should be afforded maximum flexibility in determining the appropriate level of interference protection for current TDRSS and RAS sites. The line of sight of an aircraft operating at 30,000 feet, for example, is very likely to cover far more territory than needed to protect TDRSS and RAS sites, particularly when the pointing of the involved antennas is considered. Moreover, a one-size-fits-all line-of-site approach would be overbroad because, as the Commission noted, TDRSS sites have different interference rejection filtering capabilities,

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96 *Id.*

97 *Id.* ¶¶ 23, 28.

98 *Id.*

and thus require varying levels of protection.[99] RAS sites, too, require differing protection levels.[100] Thus, the proper approach for current sites is for NTIA and AMSS operators to agree on the appropriate level of protection on a site-by-site basis. There is no need for the Commission to require AMSS operators to shutdown within the "vicinity of" such sites. Accordingly, as long as AMSS operations have been coordinated with the NTIA, the AMSS operator should be eligible for licensing.

This coordination requirement, however, should apply only to *current* TDRSS and RAS sites. Thus, the Commission's proposal for RAS that AMSS licensees be required "to coordinate only with sites listed in footnote US203"[101] should be extended to TDRSS. To this end, the current US203 should be updated to be accurate, as the Commission proposes,[102] and a list of current TDRSS sites should be included. Then, "the addition of new sites [in the future] would be subject to the notice and comment rulemaking process in order to achieve modification of footnote US203,"[103] including the list of current TDRSS sites. This type of procedure is the only way to achieve a process that is fair to AMSS providers. Otherwise, there is no way for the Commission to ensure that AMSS providers will not hamstrung by unreasonable coordination demands for future sites with unknown locations and undefined protection criteria. It is also the

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99 *See, e.g.*, *id.* ¶ 22.

100 *See, e.g.*, *ESV Order* ¶ 95 ("Three radio observatory sites were specifically mentioned in conjunction with ESVs. Cornell, the operator of the Arecibo Observatory on Puerto Rico, suggests protection in the 14.47-14.5 band from ESVs within approximately 90 km of the observatory. CORF requests protection of the radio observatories when ESVs are within 125 km of Mauna Kea, Hawaii or within 45 km of the radio observatory on St. Croix, Virgin Islands." (footnotes omitted)).

101 *NPRM* ¶ 29.

102 *Id.* ¶ 33.

103 *Id.* ¶ 29.

only way for the Commission to enforce its exhortation that NASA "endeavor to design any future TDRSS earth stations to minimize the coordination impact on AESs from TDRSS operations" and that AMSS operators "be permitted to operate in the 14.0-14.5 GHz band in the vicinity of . . . new TDRSS site[s]."[104]

VII. ADDITIONAL LICENSING, TECHNICAL, AND OPERATIONAL ISSUES.

A. The Commission Should Adopt a Fifteen-Year License Term.

As the Commission has observed, "[o]ther licensed networks of earth stations have fifteen-year license terms."[105] There is no reason to depart from the standard fifteen-year term in the AMSS context. Indeed, given that AMSS is a nascent service, the regulatory certainty that a fifteen-year term ensures is necessary to promote investment, foster early customer adoption of the service, and speed expansion of AMSS service to the public. A fifteen-year license term is reasonable and desirable, and should be adopted.

B. It Is a Prudent Measure for the Commission to Adopt Certain Safeguards from Recommendation ITU-R M.1643.

The Commission essentially has proposed adopting Sections 3 through 5 of Recommendation ITU-R M.1643, Annex 1, Part A, which pertain to closed loop tracking, NCMC monitoring and control of AESs, and AES self-monitoring.[106] These are simple but effective methods of ensuring that other uses of the Ku-band are protected.

With regard to closed loop tracking, however, the Commission should be mindful of the following two issues. ARINC's SKYLink system does not use closed loop tracking to prevent unintended satellite tracking, but instead employs a different regime to achieve the same

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104 *Id.* ¶ 24.

105 *Id.* ¶ 52 (citing 47 C.F.R. § 25.121).

106 *Compare id.* ¶¶ 42-43, *with* Recommendation ITU-R M.1643, Annex 1, Part A, Sections 3-5.

result.[107] Thus, it is important for the Commission to abstain from mandating a particular method of preventing unintended satellite tracking, as the Commission should not be in the business of picking one technology over another. Additionally, it is also critical for the Commission to recognize the fact that propagation and processing delays are inherent in all AMSS systems,[108] and therefore any requirement of an AES to "immediately inhibit transmission" must account for those types of delays.[109]

VIII. CONCLUSION.

For the reasons stated herein, the Commission should adopt AMSS service rules in accord with the above comments.

Respectfully submitted,

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[107] Specifically, SKYLink makes use of "an open-loop algorithm to optimize coupling with the target satellite, using stored ephemeris data and inputs from the aircraft's inertial navigation system." *SKYLink Order* ¶ 8.

[108] *Cf. SKYLink Order* ¶ 36 ("Any AMSS system that relays signals via a satellite (or satellites) in geostationary orbit, including Boeing's and ARINC's, will be subject to inherent lag in reception of command signals from a ground-based network-management facility.").

[109] *See NPRM* ¶ 42 ("AES terminals would have to *immediately inhibit transmission* when they detect that unintended satellite tracking has happened or is about to happen." (emphasis added)).

EXHIBIT A

TECHNICAL APPENDIX

This technical appendix provides an engineering analysis to support the Comments of ARINC Incorporated ("ARINC") filed in response to the Commission's February 9, 2005, *Notice of Proposed Rulemaking* concerning a proposed regulatory framework for licensing the operation of Aeronautical Mobile Satellite Service ("AMSS") systems.[1] ARINC submits that the Commission's proposed pointing accuracy rule – which requires that an AMSS operator "maintain pointing accuracy within 0.2 degrees for all antennas within its licensed network"[2] – should not be adopted for the reasons set forth below.

1. ***Specifying Pointing Accuracy Is Unnecessary When Specifying An Off-Axis E.I.R.P. Envelope.*** The 0.2 degree pointing accuracy proposal is unnecessary since the Commission also has specified an off-axis e.i.r.p. envelope. The off-axis e.i.r.p. mask sufficiently defines the maximum permissible power at every point in the geostationary arc East or West of the target satellite. Antenna mispointing and antenna sidelobes are fully accounted for in the application of the mask. Because the off-axis e.i.r.p. limits already takes pointing error into account, it is unnecessary and logically inconsistent to impose antenna pointing requirements in addition to the mask.

2. ***The 0.2 Degree Pointing Accuracy Rule Is Not Useful***. Geostationary satellites are spaced 2 degrees apart in the sky. Mispointing by 0.2 degrees is likely to have little or no effect on any other satellite. This is particularly true for very small aperture antennas such as those used in ARINC's SKYLink[SM] system, where required compliance with the mask already results in significant backoff in the radiated power. Figure 1 below demonstrates the simulated result of mispointing a Ku-band antenna similar to those SKYLink has operated successfully for many thousands of hours without interference to other systems.[3] The upper bound shown in the figure is 1 dB less than the Commission's proposed off-axis e.i.r.p. envelope. Even when mispointed by 4 degrees (twenty times the 0.2 degree value in Commission's proposed pointing accuracy rule), the terminal does not encroach on the off-axis e.i.r.p. Thus, regardless of the pointing accuracy specified, the off-axis mask permits a limited amount of energy to be radiated off axis. This simple fact means that any pointing accuracy specification has little, if any, value

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1 *Service Rules and Procedures to Govern the Use of the Aeronautical Mobile Satellite Service Earth Stations in Frequency Bands Allocated to the Fixed Satellite Service*, Notice of Proposed Rulemaking, 20 FCC Rcd 2906 (2005) (the "*NPRM*" or "*Notice*").

2 *NPRM* ¶ 41(i).

3 The SKYLink system has been in daily operation since June 2003, initially under an experimental license and, as of April 6, 2005, under an operational license. *See ARINC Incorporated, Application for Blanket Authority for Operation of Up to One Thousand Technically Identical Ku-Band Transmit/Receive Airborne Mobile Stations Aboard Aircraft Operating in the United States and Adjacent Waters*, Order and Authorization, 20 FCC Rcd 7553 (2005)

for protecting adjacent satellites from harmful interference. Stated differently, if emissions do not violate the mask, there is no risk of harmful interference, regardless of the particular pointing accuracy of the antenna.

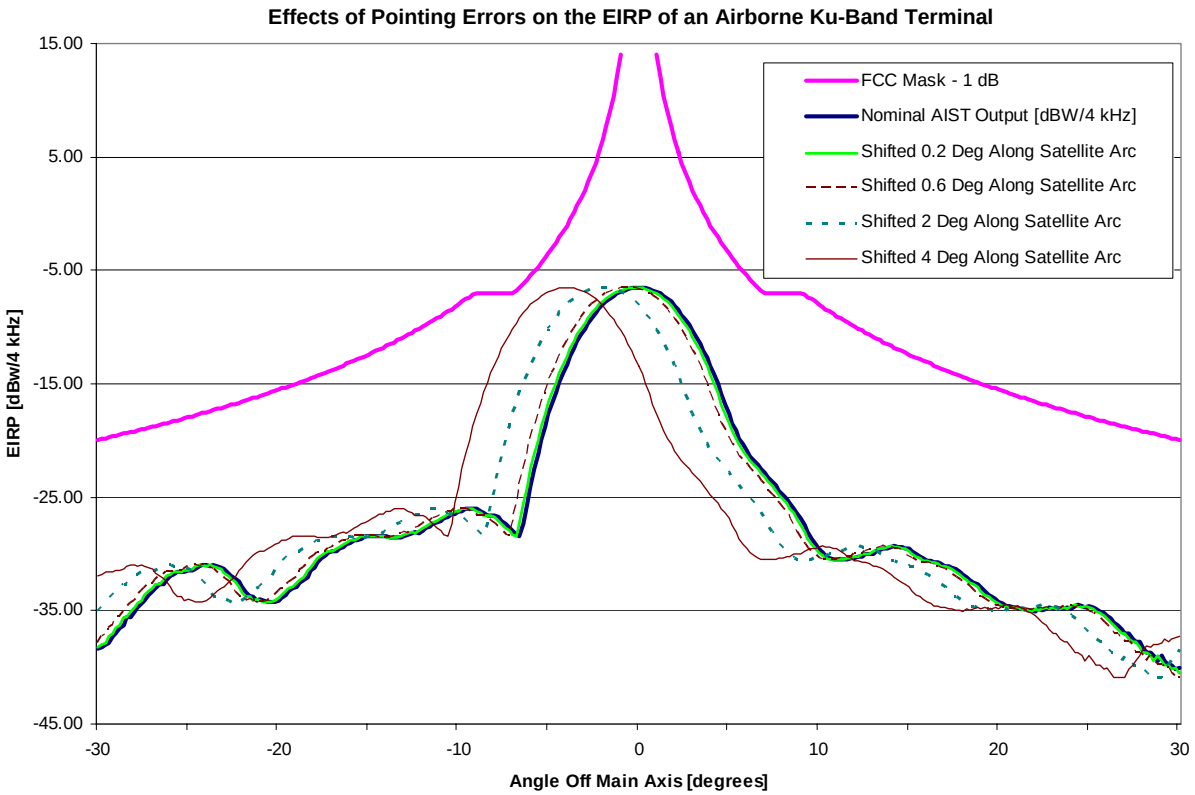

Figure 1. Effects of Mispointing in Low Power Antennas

3. ***The 0.2 Degree Pointing Accuracy Rule Limits Technological Advancement.*** The Commission's rules should permit – or even encourage – innovation and advancement in technology. ARINC's SKYLink system, for example, is based in part on managing and controlling the aggregate off-axis e.i.r.p. of all earth station terminals. The small aperture antennas used on aircraft may have a relatively large beamwidth. By limiting each terminal to the minimum power needed to close the link, as conceptualized in Figure 1 above, more users can be permitted simultaneous access to the system without exceeding the off-axis e.i.r.p. envelope. A more extreme example would be a mobile terminal that has an omnidirectional antenna with no main lobe. Specifying a pointing accuracy in such a system would have no meaning. Clearly, any pointing accuracy requirement must be a function of both antenna power and beamwidth, and the single most effective way to deal with these effects is simply to specify the off-axis e.i.r.p.

4. ***Specifying Pointing Accuracy in the AMSS Context Would Be Inconsistent with WRC-03.*** Finally, it bears noting that while Resolution 902, the WRC-03 resolution concerning

ESV technical parameters, suggests that ESV antenna maintain a peak "tracking accuracy" of 0.2 degrees,[4] no similar "tracking" or "pointing accuracy" requirement is to be found in the WRC-03 technical guidelines for AMSS.[5] This critical distinction implicitly recognizes the difference between the two operating environments. ESVs are able to carry larger antennas with more narrow beamwidths than can aircraft, especially relatively small corporate aircraft. The narrower beamwidths possible (but not required) in the ESV environment mean that small deviations in tracking accuracy will have a greater impact on the radiation toward an adjacent satellite than would be the case of the SKYLink antennas with a half-power beamwidth of 5.4 degrees. Thus, it would be incorrect, and inconsistent with the WRC-03 outcome, to import the ESV tracking accuracy specification into the AMSS environment.

* * *

In light of the above considerations, ARINC recommends that the Commission not adopt the proposed AMSS pointing accuracy rule and simply account for all pointing accuracy considerations through the specification of the mask for off-axis e.i.r.p. density. Variations in the pointing accuracies and antenna patterns of AESs and variations in the transmit E.I.R.P power from any and all AESs are fully accounted for in the off-axis e.i.r.p. mask and no additional restrictions, limitations or specifications are necessary.

4 ITU-R Resolution 902 (WRC-03), Annex 2.

5 *See* Recommendation ITU-R M. 1643.

CERTIFICATION OF PERSON RESPONSIBLE FOR TECHNICAL INFORMATION

I am the Manager of the SKYLink[SM] program at ARINC Incorporated. I certify that I am qualified to review the technical information contained in the Comments of ARINC Incorporated and the attached Technical Appendix, that I am familiar with Part 25 of the Commission's Rules, that I have prepared and/or reviewed the technical information submitted in these documents, and that it is complete and accurate to the best of my knowledge.

My technical qualifications include over 30 years of direct experience in communications and systems engineering. I hold a B.S. in Electrical Engineering from the Virginia Military Institute and an M.S. in Computer Science from The Johns Hopkins University.

By: _____

William M. Kolb
Project Manager, SKYLink[SM] Program
ARINC Incorporated

Dated: July 5, 2005

Sworn and subscribed to before me this 5th day of July 2005.

_____
Notary Public

My Commission Expires: 5-1-2006